

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of)	
)	
Use of Spectrum Bands Above 24 GHz For)	GN Docket No. 14-177
Mobile Radio Services)	
)	
Establishing a More Flexible Framework to)	IB Docket No. 15-256
Facilitate Satellite Operations in the 27.5-28.35)	
GHz and 37.5-40 GHz Bands)	
)	
Petition for Rulemaking of the Fixed Wireless)	RM-11664
Communications Coalition to Create Service)	
Rules for the 42-43.5 GHz Band)	
)	
Amendment of Parts 1, 22, 24, 27, 74, 80, 90,)	WT Docket No. 10-112
95, and 101 To Establish Uniform License)	
Renewal, Discontinuance of Operation, and)	
Geographic Partitioning and Spectrum)	
Disaggregation Rules and Policies for Certain)	
Wireless Radio Services)	
)	
Allocation and Designation of Spectrum for)	IB Docket No. 97-95
Fixed-Satellite Services in the 37.5-38.5 GHz,)	
40.5-41.5 GHz and 48.2-50.2 GHz Frequency)	
Bands; Allocation of Spectrum to Upgrade)	
Fixed and Mobile Allocations in the 40.5-42.5)	
GHz Frequency Band; Allocation of Spectrum)	
in the 46.9-47.0 GHz Frequency Band for)	
Wireless Services; and Allocation of Spectrum)	
in the 37.0-38.0 GHz and 40.0-40.5 GHz for)	
Government Operations)	

COMMENTS OF FEDERATED WIRELESS, INC.

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EXECUTIVE SUMMARY

Federated Wireless, a leader in spectrum sharing technology, was founded in 2012 by globally recognized wireless and radio communication leaders to enable and commercialize technologies that unlock the enormous potential of dynamically sharing spectrum resources. Today, Federated Wireless is leading the industry in developing shared spectrum management systems, which include cognitive radios, spectrum sensing and environmental sensing technologies, spectrum access systems, and dynamic frequency coordinators, that together dramatically improve spectrum utilization, increase the reach and reliability of wireless communication systems, and reduce the cost and complexity to deploy wireless networks. The innovative cloud-based wireless infrastructure solutions developed by Federated Wireless will break down traditional barriers to spectrum use that are found in both exclusive licensing regimes and unlicensed use regimes – avoiding the high costs of spectrum acquisition, and alleviating spectrum congestion in unlicensed bands. The result is more effective spectrum management for all users.

Federated Wireless embraces and enthusiastically supports the Commission's goals in this proceeding:

- To find new ways to access unutilized or underutilized bands above 24 GHz;
- To adopt a “flexible and modern set of rules that can facilitate [spectrum] sharing among a wide variety of users and platforms;”
- To “promote a flexible regulatory environment for the next generation of wireless services;” and
- To “enable flexibility in the uses and technologies that might be deployed in these bands in a way that also promotes coexistence between these different uses and technologies.”

In fact, Federated encourages the Commission to implement these goals even more powerfully than as proposed in the NPRM. The Commission's proposals related to the 28 GHz and 37 GHz bands, and the “use or share” regime proposed for the Upper Microwave Flexible Use Service, embrace the advantages of spectrum sharing technologies and are an encouraging step toward the future of

spectrum management. But the Commission shouldn't stop there. Given the availability of new spectrum management tools that enable spectrum sharing, the Commission need not limit itself to less flexible, historical conventions for spectrum licensing (exclusive licensing regimes, spectrum auctions, unlicensed frameworks), which are proposed for most of the bands above 24 GHz.

Federated Wireless is pleased to participate in this proceeding and highlight for the Commission how new spectrum management techniques, first leveraged for the 3.5 GHz Band, can bring the revolutionary effects of spectrum sensing and dynamic spectrum databases to other bands, including bands above 24 GHz. In this filing, Federated Wireless comments on the following:

- (1) Spectrum sharing technologies and concepts are gaining acceptance and should be applied more broadly, to the bands above 24 GHz, to solve the spectrum crunch that is facing our country;
- (2) Spectrum sharing technologies and concepts will improve spectrum utilization and are particularly important in the bands above 24 GHz because of the significant presence of incumbents;
- (3) Spectrum sharing can solve both policy and technical challenges faced by the FCC and industry by obviating the need for the Commission to predict the future of how bands will be used, and addressing technical challenges that arise in multi-user environments;
- (4) Authorizing use of sharing technology in the bands above 24 GHz, instead of using traditional licensing concepts, will dramatically improve time to market;
- (5) The Commission should adopt the hybrid licensing scheme proposed for the 37 GHz band because it will efficiently allocate spectrum for indoor uses, support an important service need, and exploit the natural propagation characteristics of the band;
- (6) The Commission should adopt its proposal to use a SAS approach to manage spectrum sharing at 28 GHz, which will help ensure the efficient allocation and use of spectrum; and
- (7) The Commission's proposed "use or share" framework for the Upper Microwave Flexible Use Service should be adopted, but implementation of this approach should not be delayed for 5 years.

The White House, Congress, and the Commission have all acknowledged the great potential that managed spectrum sharing technologies hold for the future of spectrum management. With the impending launch of 3.5 GHz Band operations and the broad array of benefits provided by

spectrum management and spectrum sharing technologies, the future is now. Federated Wireless urges the Commission to use this proceeding as a catalyst toward the widespread adoption and use of spectrum sharing technologies for the bands above 24 GHz, which will exponentially increase the capacity of these resources, future-proof regulations, protect incumbent operations, reduce interference and monitor and enforce compliance with the Commission's rules.

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COMMENTS OF FEDERATED WIRELESS, INC.

Federated Wireless, Inc. (“Federated Wireless”), an innovator in the field of new spectrum management tools, such as spectrum sensing, cloud computing, spectrum access systems, dynamic frequency coordinators, cognitive radio and small cell technology, offers these comments in response to the proposals made by the Federal Communications Commission (“Commission”) in

the above-captioned proceeding.¹ Federated Wireless embraces and enthusiastically supports the Commission's goals in this proceeding:

- To find new ways to access unutilized or underutilized bands above 24 GHz;
- To adopt a “flexible and modern set of rules that can facilitate [spectrum] sharing among a wide variety of users and platforms;”²
- To “promote a flexible regulatory environment for the next generation of wireless services;”³ and
- To “enable flexibility in the uses and technologies that might be deployed in these bands in a way that also promotes coexistence between these different uses and technologies.”⁴

In fact, Federated encourages the Commission to implement these goals even more powerfully than as proposed in the NPRM. The Commission's proposals related to the 28 GHz and 37 GHz bands (discussed at Sections III and IV herein), and the “use or share” regime proposed for the Upper Microwave Flexible Use Service (discussed at Section V herein) embrace the advantages of spectrum sharing technologies and are an encouraging step toward the future of spectrum management. But the Commission shouldn't stop there. Given the availability of new spectrum management tools that enable spectrum sharing, such as spectrum sensing, spectrum access systems and dynamic frequency coordinators, the Commission need not limit itself to less flexible, historical conventions for spectrum licensing (exclusive licensing regimes, spectrum auctions, unlicensed frameworks), which are proposed for most of the bands above 24 GHz.

In view of the significant spectrum challenges that are before us, Federated Wireless urges the Commission, in this proceeding and others to more aggressively leverage new spectrum sensing and spectrum sharing technologies as a comprehensive approach to better spectrum management

¹ See *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, et al.*, GN Docket No. 14-177, IB Docket Nos. 97-95, 15-256, RM-11664, WT Docket No. 10-112, Notice of Proposed Rulemaking, FCC 15-138 (2015) (“NPRM”).

² *Id.* at para. 2.

³ *Id.* at para. 1.

⁴ *Id.* at para. 2.

policy, and not simply as a solution for a small subset of underutilized bands. In this filing,

Federated Wireless comments on the following:

- (1) Spectrum sharing technologies and concepts are gaining acceptance and should be applied more broadly, to the bands above 24 GHz, to solve the spectrum crunch that is facing our country;
- (2) Spectrum sharing technologies and concepts will improve spectrum utilization and are particularly important in the bands above 24 GHz because of the significant presence of incumbents;
- (3) Spectrum sharing can solve both policy and technical challenges faced by the FCC and industry by obviating the need for the Commission to predict the future of how bands will be used, and addressing technical challenges that arise in multi-user environments;
- (4) Authorizing use of sharing technology in the bands above 24 GHz, instead of using traditional licensing concepts, will dramatically improve time to market;
- (5) The Commission should adopt the hybrid licensing scheme proposed for the 37 GHz band because it will efficiently allocate spectrum for indoor uses, support an important service need, and exploit the natural propagation characteristics of the band;
- (6) The Commission should adopt its proposal to use a SAS approach to manage spectrum sharing at 28 GHz, which will help ensure the efficient allocation and use of spectrum; and
- (7) The Commission's proposed "use or share" framework for the Upper Microwave Flexible Use Service should be adopted, but implementation of this approach should not be delayed for 5 years.

I. BACKGROUND ON FEDERATED WIRELESS

Federated Wireless, a leader in spectrum sharing technology, was founded in 2012 by globally recognized wireless and radio communication leaders to enable and commercialize technologies to unlock the enormous potential of dynamically sharing spectrum resources. Today, Federated Wireless is leading the industry in developing shared spectrum management systems, which include cognitive radios, spectrum sensing and environmental sensing technologies, spectrum access systems and dynamic frequency coordinators that together dramatically improve spectrum utilization, increase the reach and reliability of wireless communication systems, and reduce the cost and complexity to deploy wireless networks. The innovative cloud-based wireless infrastructure solutions developed by Federated Wireless will break down traditional barriers to spectrum use that

are found in both exclusive licensing regimes and unlicensed use regimes –avoiding the high costs of spectrum acquisition, and alleviating spectrum congestion in unlicensed bands. The result is more effective spectrum management for all users.

Since its inception, Federated Wireless has partnered with the Commission, Federal and non-Federal incumbents, wireless carriers, innovators, unlicensed user groups, and industry working groups, such as the Wireless Innovation Forum, to contribute to a flexible, innovative regulatory framework for the 3550-3700 MHz band (the “3.5 GHz Band”). The work undertaken for the 3.5 GHz Band serves as a roadmap for spectrum sharing regimes that can be widely deployed – particularly for bands above 3 GHz. For example, Federated Wireless co-founded the Spectrum Sharing Committee of the Wireless Innovation Forum, bringing together industry stakeholders to develop and advance spectrum sharing technologies based on the three-tiered architecture of the 3.5 GHz Band. Federated Wireless’s CEO volunteers his time to co-chair the Spectrum Sharing Committee.

Federated Wireless also was selected as an important partner to the federal government for developing new spectrum management tools. In September 2015, the National Advanced Spectrum and Communications Test Network announced its first test spectrum-sharing project, focused on developing spectrum sensing technology for use in the 3.5 GHz Band. Federated Wireless was asked to join this effort in combination with the Department of Defense, the National Institute of Standards and Technology, and the National Telecommunications and Information Administration.

The broad stakeholder partnerships in which Federated Wireless is involved, with foundations in both industry and government, have allowed the sensing and sharing technologies that will be leveraged for the 3.5 GHz Band to develop at a remarkable rate. Momentum is building toward the launch of successful commercial services in the 3.5 GHz Band by the end of this year.

As the Commission implicitly acknowledges in this NPRM, the 3.5 GHz Band is just the start for utilization of these sharing technologies.

Federated Wireless is pleased to participate in this proceeding and highlight for the Commission how new spectrum management techniques, first leveraged for the 3.5 GHz Band, can bring the revolutionary effects of spectrum sensing and spectrum sharing technologies to other bands, including bands above 24 GHz.

II. SPECTRUM SHARING TECHNOLOGIES AND CONCEPTS ARE GAINING ACCEPTANCE AND SHOULD BE APPLIED MORE BROADLY TO THE BANDS ABOVE 24 GHz TO SOLVE THE SPECTRUM CRUNCH THAT IS FACING OUR COUNTRY.

A. Spectrum Sharing Has Opened a New and Exciting Chapter in Spectrum Administration.

Excitement is building around the efficiencies that spectrum sharing technologies are bringing to spectrum management, and with good reason. Dynamic spectrum access technologies, such as Spectrum Access Systems (“SAS”), hold particular promise for relieving the spectrum crunch. A SAS is a dynamic database tool that provides real time coordination of spectrum while ensuring non-interference with incumbent users, managing access on a protected basis for priority users, and supporting coexistence among secondary users. A SAS utilizes location and technical operating parameters from user equipment together with collected sensor information to manage users and make spectrum available to whomever needs it when the spectrum is not in use by an incumbent or a priority user. The sensors collect information from both a network of sensors known as Environmental Sensing Capabilities (“ESCs”), deployed to detect Federal and non-Federal radio users and the environment, and sensors that conduct interference measurements and radio environment sensing.

A SAS is smart technology. It relies on learning or cognitive algorithms for spectrum management.⁵ The more it is used, the more devices it is managing, the smarter it gets. It becomes increasingly more accurate and efficient at assigning spectrum and ensuring interference protections. For a SAS, access to more data, and more experience with a radio environment, translates into more accurate modeling. As the SAS learns, it more efficiently administers scarce spectrum resources, helping to solve the spectrum crunch. Given the power of this technology, it is no accident that the White House, the Commission, and Congress have turned their attention to more use cases for spectrum sharing technologies. In this proceeding, the Commission should more assertively consider use of these technologies for all bands above 24 GHz in which it desires to manage and protect incumbent users while also making excess capacity available for new and innovative uses.

The movement to utilizing spectrum sharing technologies started with the President. In 2012, the President's Council of Advisors on Science and Technology ("PCAST") released a report in which it concluded that, given the exploding demand for commercial wireless spectrum and the continuing spectrum needs of Federal users, the traditional practice of clearing portions of federally held spectrum for exclusive commercial use was not a sustainable model for future spectrum policy.⁶ Instead, PCAST argued that the best way to increase the availability of spectrum for commercial broadband would be to leverage new technologies, such as dynamic frequency coordinators, spectrum databases, and improved interference mitigation tools, to allow spectrum to be shared among Federal and commercial users.⁷ Indeed, the PCAST Report concluded that sharing should

⁵ Using performance and spectrum measurements from managed devices, the SAS applies sophisticated machine learning techniques to continually improve propagation models and interference estimates, leading to greater spectrum utilization while enhancing safeguards for protected systems.

⁶ PCAST, Report to the President: Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth, at vi (rel. July 20, 2012) ("PCAST Report"), *available at* http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf (last accessed Jan. 21, 2016).

⁷ *Id.*

be the preferred model for spectrum management and that implementation of sharing regimes could increase the effective capacity of Federal spectrum by a factor of 1,000.⁸

In 2015, the Commission implemented the vision from the PCAST report and adopted a spectrum sharing regime and a tiered access system for the 150 MHz of spectrum in the 3.5 GHz Band that will accommodate multiple different types of uses in the band. 3.5 GHz Band users will provide the SAS with geolocation and technical parameters of the devices they deploy, which the SAS will use, in conjunction with sensing information from the ESCs, to dictate power levels and frequency assignments to the devices in a way that prevents interference to incumbent and priority users and, at the same time, ensures efficient spectrum utilization by all potential users. The framework developed for the 3.5 GHz Band is a testament to how sharing technologies can be used to support varied applications in a single band, balancing the needs of government users, incumbents, new licensed users, and unlicensed users – this model can and should be easily replicated in the bands above 24 GHz.

Beyond the Commission, support for using spectrum sharing technologies is building among lawmakers. In October 2015, President Obama signed into law the Bipartisan Budget Act of 2015,⁹ which included provisions requiring the President and the Commission to identify Federal spectrum that could be reallocated to *shared use*. The Budget Act also obligates the Commission to report to Congress on spectrum between 6 and 57 GHz that could be opened up for *shared use*.

Similarly, in November 2015 Senator Thune circulated a draft of the MOBILE NOW Act,¹⁰ which would increase the amount of spectrum made available for *sharing* through the Budget Act. The Act would require the Secretary of Commerce and the FCC to make available a total of 255

⁸ *Id.*

⁹ Bipartisan Budget Act of 2015, Pub. L. No. 114-74, 129 Stat. 584.

¹⁰ Making Opportunities for Broadband Investment and Limiting Excessive and Needless Obstacles to Wireless Act (Discussion Draft 2015), *available at* <http://src.bna.com/YL> (last accessed Jan. 21, 2016).

MHz of spectrum below 3550 MHz for mobile and fixed uses, and notes that the spectrum could be made available using a *shared use regime*, in addition to considering exclusive licensing or unlicensed use.

Also in November 2015, Senator Schatz introduced the Promoting Unlicensed Spectrum Act of 2015,¹¹ which would require the Commission to develop a strategy to make additional spectrum available for unlicensed operations. The bill would further require the strategy to take into consideration a number of *potential sharing models, including “expanding utilization of the spectrum sharing model implemented by the Commission” in the 3.5 GHz Band.*

Clearly, the White House, Congress, and the Commission have recognized the enormous value that spectrum sharing technologies could provide, and the Commission should take steps in this proceeding to build on this growing momentum and more broadly implement sharing technologies for all of the bands above 24 GHz.

B. Spectrum Sharing Technologies and Concepts Will Improve Spectrum Utilization and Are Particularly Important in the Bands Above 24 GHz Because of the Significant Presence of Incumbents.

The Commission itself acknowledged, as early as 2010, that dynamic spectrum access regimes have the potential to greatly improve efficiency in the way spectrum is used. Federated Wireless agrees with the Commission that “[d]ynamic spectrum access radios, as well as the new spectrum management techniques that they can enable, hold great promise as we seek to use our nation’s available spectrum resources more intensively and efficiently.”¹² By leveraging these technologies to identify and allocate spectrum that is not in use, and is therefore available in a particular area for some period of time, dynamic spectrum access systems will ensure that limited spectrum resources do not go underutilized at a time when bandwidth demands are growing

¹¹ S.R. 2278, 114th Cong. (2015).

¹² *Promoting More Efficient Use of Spectrum Through Dynamic Spectrum Use Technologies*, ET Docket 10-237, Notice of Inquiry, FCC 10-198, at para. 16 (2010).

exponentially. Indeed, “[e]nsuring that we can take advantage of these improved efficiencies will be critical as we address a looming spectrum crisis, and can lead to increased spectrum value that spurs additional investment and innovation that can benefit American consumers.”¹³

The 3.5 GHz Band provides a powerful example of this effect. Part of the band, spectrum from 3550-3650 MHz, was previously reserved exclusively for Federal users and other incumbents, where it is employed largely for offshore radar systems by the U.S. Navy, and FSS earth station operations. The spectrum was not in use in the vast majority of the country. However, with the creation of the 3.5 GHz Band, administered by a SAS, this 100 MHz of valuable spectrum will now be made available for innovative small cell uses that meet demand for much-needed wireless capacity while also ensuring that Federal and non-Federal incumbent operations are protected from interference by newly authorized commercial operations. The 3.5 GHz Band will benefit from the efficiencies created by opening up new spectrum to commercial use by also permitting opportunistic use of unused spectrum. Where the SAS is aware that licensed 3.5 GHz Band spectrum is not currently being used by the licensee, it will permit unlicensed users access to the spectrum for their operations, further ensuring that the spectrum does not go underutilized.

Similar to the 3.5 GHz Band, there are spectrum incumbents in many of the bands above 24 GHz that will need protection as the bands are opened to new uses. In the 28, 37, 39, and 64-71 GHz bands, incumbents include fixed LMDS licensees, fixed point-to-point and point-to-multipoint licensees, Federal FSS operations, Federal MSS operations, non-Federal FSS operations, Federal fixed and mobile services, Federal space research operations, Federal and non-Federal Radiolocation services, and Federal and non-Federal Radionavigation-Satellite operations. SAS technology was developed to, and is ideally suited to, assist with incumbent protection, spectrum transition, and cooperative use. As demonstrated in the 3.5 GHz Band proceeding, dynamic spectrum access

¹³ *Id.*

databases can and will simultaneously protect incumbent operations from interference generated by newly authorized mobile operations and authorize those new operations in a way that brings significant swaths of spectrum to market. Given the significant presence of incumbent operations in the bands above 24 GHz, the use of a dynamic spectrum access tool to manage incumbent interference protection and authorize new mobile operations would best balance the interests of these two user groups, and accomplish the Commission's goals in this proceeding.

In addition, the propagation and spectral reuse characteristics of the bands above 24 GHz make them especially well-suited to more active spectrum management which can be administered by a SAS. This is generally the case for all spectrum above 3 GHz, which is the point at which the combination of propagation characteristics and relatively low-power operations make spectral reuse commercially viable. There is every reason why spectrum sensing and spectrum sharing advances should be made available in the bands above 24 GHz, just as they have been made available in the 3.5 GHz Band.

C. Spectrum Sharing Can Solve Both Policy and Technical Challenges Faced by the FCC and Industry.

Shared spectrum frameworks and SAS technology can ease both FCC policy challenges and industry technical challenges around spectrum use in multi-user environments and when business cases are not clear -- both of these challenges are present in the bands above 24 GHz.

1. Authorizing Spectrum Sharing Obviates the Need for the Commission to Predict Future Uses for a Spectrum Band.

Authorizing use of spectrum bands above 24 GHz through sharing technologies would relieve the Commission of the need to predict future uses for the bands, or adopt rules today with particular technologies or future uses in mind. A flexible sharing framework, based upon a minimal set of common technical standards and utilizing a SAS to manage a wide variety of uses and technologies, provides a flexible framework that will encourage use cases to develop over time

without lengthy FCC rulemakings that can serve as a bottleneck. When SAS technology is deployed in a band, the SAS evolves as the technology and use cases evolve – optimizing both. Such an approach would be particularly valuable for the bands above 24 GHz that are presently under consideration. There is no clear business case for these bands today. The Internet of Things is widely discussed, but it is still more theoretical than it is a reality, and there are no 5G standards in place. Such standards will likely not exist until well after this proceeding is concluded.¹⁴

There is an undeniable parallel between the uncertain market expectations for 5G today and those in the past that precipitated the Commission to adopt the current, unworkable service rules for the 28 and 39 GHz bands which have left this spectrum to languish for decades. The experience there should be instructive to the Commission, as technical rules were put in place based on expected demand and technological developments that did not materialize. Market conditions changed—the price for fiber dropped and deployments to supply backhaul over millimeter wave bands stymied. Consequently, use cases for those bands, as reflected in the technical rules, fell away, and the swaths of spectrum allocated for those uses were left underutilized and unavailable for other uses.¹⁵ In view of the historical underutilization produced by the employment of traditional spectrum management models for these and other bands, the Commission should question the wisdom of applying those same models today, when more flexible, responsive spectrum sharing approaches are available.

Authorizing an adaptable approach for the bands above 24 GHz, incorporating use of sensing and sharing technologies, would future-proof the regulations for the bands, obviating the need for the Commission to guess at future use cases, and minimizing the time, cost, and impact of

¹⁴ Mid last year the Third Generation Partnership Project (3GPP) endorsed a timeline for the standardization of 5G wireless technology, which calls for finalization of the standards sometime in 2020. *See* 3GPP, Tentative 3GPP Timeline for 5G (published March 17, 2015), *available at* http://www.3gpp.org/news-events/3gpp-news/1674-timeline_5g.

¹⁵ This underutilization also has imposed significant administrative burdens and forced the Commission to reallocate limited resources to consider requests to extend build out deadlines, issue and fight license revocations, review secondary market transactions, and address related matters that continue to demand time and attention today.

implementing modified regulations as technology and business cases change. The Commission should entrust oversight and management of flexible operations in the bands to the SAS and, as technology develops, business cases evolve, and rules are modified, authorize any necessary alterations to be fed into the SAS for seamless implementation and management.

2. Authorizing Spectrum Sharing Technologies Will Assist Industry in Addressing Technical Challenges.

The Commission will encourage the development of new spectrum management tools to enhance spectrum utilization if spectrum sharing is more widely authorized for the bands above 24 GHz. These tools could include new approaches to interference management, incumbent protection, and dynamic adjustment of power limits, tools to encourage more frictionless secondary uses, tools to ensure regulatory compliance by users, and tools and spectrum that will provide carriers with readily available capacity to densify their networks, reducing the near-term need for 5G capacity. A similar scenario has borne out in the 3.5 GHz Band proceeding, as the Commission, government stakeholders, incumbent FSS users, prospective SAS administrators and potential mobile licensees are working toward technology solutions to just these questions.

The SAS is particularly useful for protecting and transitioning incumbent uses, while also affording new users with access to unused spectrum. Similar to the 3.5 GHz Band, managing these two goals is important to the bands above 24 GHz. In the 3.5 GHz Band, in addition to serving as the spectrum administrator, the SAS will serve as a transitional element as grandfathered wireless broadband licensees in the 3650-3700 MHz band will continue to operate, with interference protections provided by the SAS, as they move toward new operating conditions under the 3.5 GHz Band service rules. During the transitional period, grandfathered licensees may continue to operate under the Part 90 Subpart Z rules until the moment when they are required to transition to the new service rules for the 3.5 GHz Band. This approach provides a number of policy, technological, and economic benefits. First, the spectrum on which the grandfathered licensees operate is available on

a shared basis for mobile operations immediately, as opposed to forcing mobile users to wait until the grandfathered licensees are fully transitioned. Second, grandfathered licensees are given sufficient time to plan and implement an orderly transition, and there is no need for the Commission to set overly aggressive timelines to incent the grandfathered licensees to transition or satisfy the needs of new uses for the spectrum in a timely manner. Third, the grandfathered licensees are able to reduce the cost of the transition by changing out equipment through normal technology replacement or upgrade cycles. Finally, to execute the transition, the Commission's administrative burden is largely limited to updating ULS registrations and setting a simple engineering requirement for grandfathered licensee protection, as the SAS governs all 3.5 GHz Band device operations and implements the Commission's protection requirements.

The SAS can not only facilitate transitional sharing as particular spectrum bands evolve, but it also can facilitate sharing in multi-user environments, and implementation of license overlay strategies. Moreover, the scalability and resiliency of the cloud allows the SAS to easily handle the volume and complexity of computations required to implement a dynamic spectrum sharing regime. By leveraging the computational capacity of the cloud, a SAS allows end user equipment in any band to negotiate directly with the SAS in a frictionless and transparent manner for frequency allocation, power limits, antenna gain, and other operational parameters, which makes the equipment effectively auto-configurable and operation of the equipment transparent to the end user.

An additional technology advantage of using a SAS is that it will shift much of the cost of regulatory compliance, or adapting to changes in regulation, from the hardware used in a band to the software in the SAS that manages the band—resulting in significant cost savings. With service rules and a certified SAS in place, equipment manufacturers can simply certify that the operations of their hardware are controlled by the SAS, and leave it to the SAS to allocate spectrum in a manner that complies with the rules of the band and prevents interference. Moreover, because the SAS dictates

the operations of devices in the band, the SAS can simplify the Commission's efforts to monitor and ensure compliance with the rules and enforce any corrective action. The SAS makes regulatory enforcement a more affirmative system by providing a single point of contact for numerous different network operators, providing independent logs of spectrum activity available for Commission auditing and analysis, and providing knowledge of registered device locations.¹⁶

Given the flexibility and responsiveness of SAS technology, there is every reason to apply SAS technology, or a similar database-centered approach, more broadly in the Commission's spectrum management efforts, including for the bands above 24 GHz.

D. Authorizing Use of Sharing Technology in the Bands Above 24 GHz, Instead of Using Traditional Licensing Concepts, Will Dramatically Improve Time to Market.

In the NPRM, the Commission proposes to establish traditional, exclusive access licensing schemes for the 28 and 39 GHz bands, and a new “hybrid” approach for the 37 GHz band that nonetheless anticipates auctioning exclusive spectrum rights to license holders. In fact, with respect to the 28, 37 and 39 GHz bands, the Commission proposes using auctions as a way of making spectrum available. With respect to the 64-71 GHz band, the Commission proposes adopting a traditional unlicensed framework. As discussed below, using these traditional licensing techniques will require the successive development of service and technical rules, conducting one or more auctions, adopting standards for the equipment, manufacturing equipment and deploying it. These successive, incremental steps can—and have—lead to years-long efforts to bring spectrum to market. In view of the spectrum crunch facing our country, waiting years to bring the bands above 24 GHz to market, for a second time, is untenable and unnecessary – especially in view of the flexibility afforded by dynamic spectrum management technologies.

¹⁶ See, e.g., PCAST Report at 102.

As opposed to other bands in which the Commission utilized traditional licensing techniques, which took several years or more to bring to market, the 3.5 GHz Band is expected to launch by the end of this year, less than 4 years after the Commission first proposed shared use of the band by incumbents and new users in December 2012. Bringing this band to market later this year is a significant accomplishment given the substantial efforts of FCC staff and industry to implement the ground-breaking sharing model.

The time to market for the 700 MHz band, authorized using traditional licensing techniques, stands as a stark contrast to the 3.5 GHz Band. For the 700 MHz band, the lag between the conduct of an auction, the adoption of service rules, the standards setting work (Band 12 and 17 issues) and the development of technology to support the uses desired by the auction winners, took more than 18 years—and counting—to bring to market.¹⁷ One of the big problems with the current model of spectrum allocation is that standards and technology only develop after licenses are awarded and licensees make known their plans for using the spectrum.

The 2.5 GHz band is another example of the Commission and industry suffering through successive licensing regimes, including a spectrum auction, only to have this spectrum languish for decades. Since the creation of the ITFS in 1963 and MDS in 1974, the Commission and industry have consistently and repeatedly struggled to keep pace with market and technological developments and make 2.5 GHz spectrum viable. A grim illustration of these struggles is provided by the fact that significant changes to the service rules in the band were made in 1983, 1985, 1987, 1991, 1993, 1996, 1998, 2001, and 2004, all in an attempt to increase the utilization of 2.5 GHz spectrum. Despite the Commission's and industry's best efforts, the implementation of these changes have

¹⁷ The Commission first proposed to reallocate 700 MHz spectrum for wireless use in 1997 (Upper 700 MHz) and 2001 (Lower 700 MHz). Following protracted Commission proceedings, numerous auctions, and the creation of non-interoperable standards between 3GPP band classes 12 and 17, 700 MHz Lower A Block spectrum still has not been fully deployed for commercial wireless use nearly two decades later.

lagged behind developing technology and business cases, and the 2.5 GHz band remains underutilized today.

Contrast these experiences with the Commission's approach to the 71-76, 81-86, and 92-95 GHz bands, which provide a useful case study for the effects of efficient, flexible licensing frameworks on the utilization of spectrum. The Commission recognized that these bands were undeveloped and available for new uses, and as a result adopted a non-exclusive nationwide licensing approach. Under this approach, prospective users obtain a nationwide license and register their individual point-to-point links. This registration and "light licensing" is far less burdensome and more efficient than a more traditional spectrum licensing process, and provides for instant registration in most cases. The Commission's innovative, flexible approach in these bands produced a sharp increase in the utilization of the spectrum, and it should build on the steps it took there by availing itself of new tools that could even more significantly increase the use and speed to market of the bands above 24 GHz.

The model just discussed, and the 3.5 GHz Band model, both present efficiencies that should be considered for the bands above 24 GHz. In the 3.5 GHz Band, all equipment and use cases are governed by the same service rules and all devices are required to be interoperable. As a result, manufacturers are able to begin building to the rules before an auction has been conducted, ensuring that suitable technology will be available upon the close of the auction and significantly reducing the time to market. This is the model that should be used for the bands above 24 GHz.

III. AT A MINIMUM, THE COMMISSION SHOULD ADOPT THE HYBRID LICENSING SCHEME PROPOSED FOR THE 37 GHz BAND BECAUSE IT WILL EFFICIENTLY ALLOCATE SPECTRUM FOR INDOOR USES, SUPPORT AN IMPORTANT SERVICE NEED, AND EXPLOIT THE NATURAL PROPAGATION CHARACTERISTICS OF THE BAND.

Federated Wireless supports the Commission's proposed hybrid licensing scheme for the 37 GHz band to convey licensed-by-rule "local area" operating rights for indoor use by premises

occupants and, separately, award geographic area licenses for wide area use. Under this proposal, indoor local area operating rights for spectrum access within the boundary of a particular facility would be awarded by rule under Section 307(e) of the Communications Act.¹⁸ Wide area use rights would be awarded by auction, and would entitle licensees to deploy service in any and all areas not awarded through the local area licensing-by-rule. By doing so, the Commission seeks to exploit the physical properties of the spectrum, to facilitate “privately deployed networks that can provide 5G communications for advanced and industrial applications not suited to unlicensed spectrum or public network services.”¹⁹

Federated Wireless agrees with the Commission, that “[t]he inherent short-range characteristics of millimeter wave spectrum make it well-suited to serve this need, and might also facilitate natural coexistence between a private, local area network, and a more traditional commercial wide area network.”²⁰ Federated Wireless also agrees that it would be “highly efficient” to convey to premises occupants the initial spectrum rights for indoor environments in which there is a need to support applications “not suited to unlicensed spectrum or public network services.”²¹ Affording adequate spectrum rights for indoor uses is consistent with the goal of assigning spectrum resources to promote the best and highest use.

Today, achieving adequate indoor broadband coverage is not occurring both because unlicensed solutions are inadequate and negotiations between carriers and property owners often fail to result in viable agreements for indoor service.²² Unlicensed band Wi-Fi remains the prevalent solution for wireless service within buildings. The benefits of unlicensed spectrum and Wi-Fi are

¹⁸ See 47 U.S.C. § 307(e).

¹⁹ NPRM at para. 100.

²⁰ *Id.*

²¹ *Id.*

²² See *id.* at para. 101.

undeniable, but the ever-increasing scale and density of Wi-Fi systems coupled with explosive data traffic growth make it an untenable solution for the enterprise into the future. History repeats itself, so we should only assume that present day challenges for Wi-Fi—congestion resulting in spotty and unpredictable service quality—will reoccur in unlicensed bands above 24 GHz.

Efforts to deploy licensed solutions indoors also have not met with success. We have seen the net result of the conflict between spectrum and real estate rights. Just 2% of indoor locations nationwide have internal access to licensed wireless broadband today, notwithstanding that technology for in-building solutions has existed for years. The Commission’s hybrid licensing proposal will provide a mechanism for affordable and robust indoor wireless broadband including for hospitals, governments, utilities, schools, and manufacturing facilities.

The hybrid approach proposed in the NPRM will afford both building owners and carriers with the spectrum each needs. The simple and valuable application of the hybrid model to the 37 GHz band will not complicate operations in the band. There are a variety of ways to effect this coordination, including through use of a Spectrum Access System. No further solutions need to be developed beyond the basic functionality of the SAS.

IV. THE COMMISSION SHOULD ADOPT ITS PROPOSAL TO USE A SAS APPROACH TO MANAGE SPECTRUM SHARING AT 28 GHz, WHICH WILL HELP ENSURE THE EFFICIENT ALLOCATION AND USE OF SPECTRUM.

In the NPRM, the Commission seeks comment on whether to authorize the use of Fixed Satellite Service (“FSS”) fixed user equipment on a secondary basis in the 28 GHz band. The Commission further seeks comment on how to manage spectrum sharing in the band and ensure that the operation of these devices does not interfere with the primary operations of terrestrial mobile licensees, and proposes the use of a SAS as a potential solution to this problem.

Federated Wireless supports the proposal to employ a SAS to manage spectrum sharing among primary terrestrial operations and FSS fixed user equipment deployed on a secondary basis.

Federated Wireless agrees with the commenters to the NOI that “many of the scenarios pointed out in the NOI for mobile wireless services in high-band spectrum are conducive to opportunistic uses by small satellite terminals through cognitive sharing techniques (including dynamic spectrum databases).”²³ A SAS approach to managing sharing in the 28 GHz band would ensure that spectrum in the band is efficiently allocated among potential uses across the country, particularly in view of the fact that “[t]errestrial base stations for mobile operations in the mmW bands will likely have small coverage areas and limited aggregate coverage . . . leaving expansive territory available for satellite operators to make opportunistic use of the same spectrum in nearby areas, based on information regarding the locations and frequencies of terrestrial base stations.”²⁴ Managing uses in the 28 GHz band by FSS users and other users by deploying a SAS is consistent with what the SAS will accomplish in the 3.5 GHz Band.

The Commission further seeks comment on what information terrestrial licensees must provide to the SAS administrator in order to allow the administrator to manage sharing in a way that prevents interference to primary operations. Federated Wireless agrees that terrestrial licensees in the 28 GHz band should be required to provide the SAS with geographic coordinates and technical parameters for their links and base stations similar to the information required on Form 601, Exhibits D, H, and I. As additional information needs are identified, the Commission should allow for industry (*e.g.*, a multi-stakeholder standards body) to define them. Further, any information provided to the SAS that is not otherwise disclosed to the public should be considered confidential and used solely for the purpose of spectrum management by the SAS. Federated Wireless also agrees that terrestrial licensees should not be required to provide pertinent operating information until the licensee is notified by an FSS operator that it “will soon begin deploying” fixed user

²³ *Id.* at para. 151.

²⁴ *Id.*

equipment in the licensee's geographic service area or other area of operation; appropriate coordination can follow thereafter.²⁵

V. THE COMMISSION'S PROPOSED "USE OR SHARE" FRAMEWORK FOR THE UPPER MICROWAVE FLEXIBLE USE SERVICE SHOULD BE ADOPTED, BUT IMPLEMENTATION OF THIS APPROACH SHOULD NOT BE DELAYED FOR 5 YEARS.

In the NPRM, the Commission proposes to implement a "use-or-share" obligation that would require 28, 39, and 37 GHz licensees in the newly created Upper Microwave Flexible Use Service ("UMFUS") to provide service to their entire license areas within 5 years after license issuance. If there are any portions of a license area that remain unused at that time, those portions would be made available for shared use.²⁶

As an initial matter, Federated Wireless agrees with the Commission that "[o]ne of the most important characteristics of bands above 24 GHz is that the propagation and atmospheric absorption characteristics result in shorter range communications," which provides "greater opportunity for frequency reuse without interference."²⁷ As a result, these high-frequency bands are indeed "particularly good candidates for sharing."²⁸ However, the Commission should look to the example of the 3.5 GHz Band and the availability of SAS technology today, and conclude that there is no reason to delay implementation of sharing in the UMFUS.

Rather than waiting 5 years, a dynamic spectrum management system such as a SAS could be deployed at the outset, detecting where there is unused spectrum at any time and permitting opportunistic use, on a non-interfering basis, immediately upon launch of the service. Any desired traditional licensing procedures could proceed in parallel. This would further the Commission's goal of ensuring that the nation's scarce spectrum resources do not lie fallow in the hands of either the

²⁵ *Id.* at para. 153.

²⁶ *Id.* at para. 216.

²⁷ *Id.* at para. 215.

²⁸ *Id.*

Commission or a licensee, and allow innovative uses for these and other bands to develop on opportunistically available spectrum.

The White House, Congress, and the Commission have all acknowledged the great potential that spectrum sharing technologies hold for the future of spectrum management. With the impending launch of 3.5 GHz Band operations and the broad array of benefits provided by SAS technology, the future is now. Federated Wireless urges the Commission to use this proceeding as a catalyst toward the widespread adoption of spectrum sharing technologies that will exponentially increase the capacity of our scarce spectrum resources and future-proof regulations, all the while protecting incumbent operations, reducing interference and ensuring compliance with the Commission's rules.

VI. CONCLUSION

Given the emerging success story of the 3.5 GHz Band, and the availability of dynamic spectrum database technologies, such as the SAS, that can leverage the power of cloud computing to enable dynamic spectrum sharing among incumbents and new users, now is the time for the Commission to begin seriously considering a new way of thinking about spectrum management. This is particularly so as more and more broadband-intensive applications develop and bandwidth demands grow exponentially, placing ever-increasing pressure on the finite amount of commercially viable radio spectrum available. In view of the myriad advantages provided by spectrum sharing technologies and their applicability to all high-frequency bands above 3 GHz, the Commission should not only adopt its proposal to employ SAS technology in the 28 GHz band and its hybrid approach in the 37 GHz band, but it also should widen its lens, even with respect to its "use or share" proposal and authorize use of sharing technologies in all of the bands above 24 GHz without delay. Federated Wireless looks forward to working with the Commission in exploring how new

frontiers and new spectrum management technologies can be brought to bear for the most spectrum-efficient results in bands above 24 GHz.

Respectfully submitted,

_____/s/_____
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